anterior edge extending forward quite as far as the edge of the mantle, and considerably beyond the insertion of the fin, which is itself well forward. The length of the fin is about two-thirds that of the body; the base or insertion of the fin equals about one-half of the body-length; the breadth of the fin is greater than one-half the breadth of the body. Head large, rounded, with large and prominent eyes; lower eyelid slightly thickened. Arms rather small, unequal, the dorsal ones considerably shorter and smaller than the others. In the male, the left dorsal arm is greatly modified, and very different from its mate. Lateral and ventral arms are subequal.

In both sexes, and even in the young, the suckers along the middle of all the lateral and ventral arms are distinctly larger than the rest, but in the larger males this disparity becomes very remarkable, the middle suckers (Pl. XLVI, figs. 3*a*–3*b*) becoming greatly enlarged and swollen, so that eight to ten of the largest are often six or eight times as broad as the proximal and distal ones; they are deep, laterally attached, with a raised band around the middle, and a very small round aperture, furnished with a smooth rim. In the female the corresponding suckers on the lateral arms are about twice as broad as the rest. The suckers are in two regular rows, on the lateral and ventral arms, in both sexes. In the male, the left dorsal arm becomes thickened and larger from front to back, and is usually curled backward; its suckers become smaller and much more numerous than on the right arm, being arranged in four crowded rows, except near the base, where there are but two; the sucker-stalks also become stout and cylindrical, or tapered, their diameter equalling that of the suckers (Pl. XLVI, fig. 3; Pl. XLVII, fig. 5). The right arm remains normal, with two alternating rows of suckers, regularly decreasing to the tip, as in both the dorsal arms of the female. Tentacular arms long, slender, extensible; club distinctly enlarged, usually curled in preserved examples (Pl. XLVI, figs. 2*a*, 3). The suckers on the club are numerous, unequal, arranged in about eight close rows; those forming the two or three rows next the upper margin (Pl. XLVII, figs. 5*a*–5*b*) are much larger than the rest, being three or four times as broad, and have rows of small scale-like denticles around the rims, the marginal ones larger.

Color, in life, pale and translucent, with scattered rosy chromatophores. In the acoholic specimens, the general color of the body, head, and arms is reddish, thickly spotted with rather large chromatophores, which also exist on the inner surface of the arms, between the suckers, and to some extent on the tentacular arms and bases of the

fins; outer part of fins translucent white; anterior edge of mantle with a white border.

Pen small and very thin, soft, and delicate. It is angularly pointed or pen-shaped anteriorly, the shaft narrowing backward; a thin lanceolate expansion, or margin, extends along nearly the posterior half (Pl. XLVI, fig. 2*b*).

Upper jaw with a sharp, strongly incurved beak, without a notch at its base. Lower jaw with the tip of the beak strongly incurved, and with a broad, but prominent, rounded lobe on the middle of its cutting edges (fig. 2*c*).

Odontophore with simple, acute-triangular median teeth; inner laterals simple, nearly of the same size and shape as the median, except at base; outer laterals much longer, strongly curved forward (fig. 2*d*.)

Length of body 25 to 40$^{mm}$. One of the larger males measures, in alcohol, from the posterior end of the body to the dorsal edge of the mantle, 21$^{mm}$; to the free bases of the dorsal arms, 48$^{mm}$; to the interval between bases of second and third pairs, 49$^{mm}$; to bases of ventral arms, 46$^{mm}$; to tip of dorsal arms, 48$^{mm}$; of second pair, 51$^{mm}$; of third pair, 49$^{mm}$; of ventral arms, 46$^{mm}$; diameter of largest suckers of lateral arms, 2$^{mm}$; length of fin at base, 11$^{mm}$; extreme length of fin, 15·5$^{mm}$; transverse breadth of fin (lower side), 10$^{mm}$; diameter of eye, 9$^{mm}$; breadth of body, below fin, 17$^{mm}$; breadth of head, 17$^{mm}$.

Twenty-seven specimens of this species were obtained by Mr. A. Agassiz, on the "Blake," in 1880, from six stations, ranging in depth from 71 to 233 fathoms. Later in the same season, over 200 specimens were secured by the writer and others of the dredging party on the United States Fish Commission steamer "Fish-Hawk." It was particularly abundant at stations 869, 870 and 871, in about 125 to 192 fathoms, on the rapidly sloping outer bank, off the coast, under the inner edge of the Gulf Stream, where the bottom consists of fine compact sand, with mud and shells. Both sexes occurred in about equal numbers, and also the young, of various sizes. It was also taken in considerable numbers at stations 865 to 867, in 65 fathoms; 872 to 880, in 85 to 252 fathoms. It was also dredged off the mouth of Chesapeake Bay, in November, by Lieut. Z. L. Tanner, on the "Fish Hawk," in 18 to 57 fathoms.

It is easily distinguished from all the species of *Rossia* by the larger size of the suckers along the middle of the lateral arms; by the inequality of the suckers on the tentacular clubs; and by the peculiar hectocotylized condition of the left dorsal arm of the male. The ex-

istence of large chromatophores on the inner surface of the arms, between the suckers, is also a good diagnostic mark, by which to distinguish it from our species of *Rossia*, which have the corresponding parts nearly white, or with few and small chromatophores.

*Heteroteuthis tenera.— Specimens examined.*

| Stat. | Locality. N. Lat. | W. Long. | Depth, Fathoms. | When received. | Specimens. No. Sex. |
|---|---|---|---|---|---|
| | *U. S. Fish Com. Off Martha's Vineyard.* | | | 1880 | |
| 865 | 40° 05′ | 70° 23′ | 65 | Sept. 4, U. S. F. C. | 3 ♂ 7 ♀ |
| 866 | 40 05 18″ | 70 22 18″ | 65 | " " " | 3 ♂ 6 ♀ |
| 867 | 40 05 42 | 70 22 06 | 64 | " " " | 4 ♂ 10 ♀ |
| 869 | 40 02 18 | 70 23 06 | 192 | " " " | 20+, ♂ & ♀ |
| 870 | 40 02 36 | 70 22 58 | 155 | " " " | 15 ♂ 17 ♀ |
| 871 | 40 02 54 | 70 23 40 | 115 | " " " | 18 ♂ :11 ♀ :32 j |
| 872 | 40 05 39 | 70 23 52 | 86 | " " " | 1 ♂ 2 ♀ |
| | *Off Newport, R. I.* | | | | |
| 873 | 40° 02′ | 70° 57′ | 100 | " 13, " " | 5 ♂ 1 ♀ |
| 874 | 40 00 | 70 57 | 85 | " " " | 10 ♂ 6 ♀ |
| 875 | 39 57 | 70 57 30″ | 126 | " " " | 1 ♂ |
| 876 | 39 57 | 70 56 | 120 | " " " | 8 ♂ 6 ♀ |
| 877 | 39 56 | 70 54 18 | 126 | " " " | 6 ♂ 4 ♀ |
| 878 | 39 55 | 70 54 15 | 142½ | " " " | 1 ♂ 1 ♀ |
| 879 | 39 49 30″ | 70 54 | 225 | " " " | 6 |
| 880 | 39 48 30 | 70 54 | 252 | " " " | 2 ♂ |
| | *Off Chesapeake Bay.* | | | | |
| 899 | 37° 22′ | 74° 29′ | 57½ | Nov. 16, " " | 3 ♂ 2 ♀ |
| 900 | 37 19 | 74 41 | 31 | " " " | 1 j. |
| 901 | 37 10 | 75 08 | 18 | " " " | 21 ♂ 3 ♀ |
| | *Blake Expedition, U. S. Coast Survey.* | | | | |
| 313 | Off Charleston, S. C. | | 75 | 1880 | 7 ♂ 5 ♀ |
| 314 | 32° 24′ | 78° 44′ | 142 | 1880 | 2 ♂ 1 ♀ |
| 316 | 32 7 | 78 37 30″ | 229 | 1880 | 1 ♀ j. |
| 321 | 32 43 25″ | 77 20 30 | 233 | 1880 | 5 ♀ |
| 327 | 34 0 30 | 76 10 30 | 178 | 1880 | 1 ♂ 3 ♀ |
| 345 | 40 10 15 | 70 4 30 | 71 | 1880 | 2 ♀ j. |

## Order II.—OCTOPODA Leach.

*Cephalopoda octopoda* Leach, Zool. Miscel., iii, 1817 (t. Gray).

Férussac Tableau Syst., p. 18, 1821.

D'Orbigny, Tab. Method., p. 45, 1825; D'Orbigny, Céphal. Acétab., p. 1.

*Octocera* Blainv., Dict. Sci. Nat., vol. xxxii, 1824.

*Octopia* Gray, Cat. Moll. Brit. Mus., i, p. 3, 1849.

Arms eight, similar, all furnished with suckers in one or two rows; often more or less united by a web, without natatory crests. Suckers sessile, not oblique, destitute of horny rings or hooks. No tentacular arms. Head often larger than the body. Body short and

thick, obtuse posteriorly, usually destitute of fins. Fins, when present, small, lateral, supported by an internal transverse cartilage. Mantle usually extensively united to the head by a dorsal commissure. Siphon without an internal valve. Branchial cavity divided into two parts by a median septum, extending forward to the base of the siphon, but interrupted posteriorly. No olfactory crests. Eyes united to the internal lining of the sockets, so as to be immovable, usually furnished with lids. No outer buccal membrane. Aquiferous pores and cavities usually absent; cephalic pores sometimes present. Internal longitudinal shell or pen absent. An external shell is present only in the genus Argonauta. In this case it is formed as a secretion from the inner surface of the expanded distal portion of the two dorsal arms, of the female only, and serves mainly as a receptacle for the eggs. The right arm of the third pair is hectocotylized in the male. Sometimes the entire arm is modified and sometimes the tip only.

### Family PHILONEXIDÆ D'Orbigny.

*Philonexidæ* (*pars*) D'Orb., Moll. Viv. et Fos., i, 199, 1845 (t. Gray).
Gray, Catal. Moll. Brit. Mus., i, p. 24, 1849.
Kefferstein, in Bronn, Thier-Reich., iii, 2 B., p. 1449, 1866.

Body stout, oval, destitute of lateral fins. Branchial opening large. Edge of mantle united to the base of the siphon laterally by a complicated prominent cartilage or button fitting in a corresponding pit on the inner surface of the mantle. Dorsal commissure narrow. Head with aquiferous pores communicating with large aquiferous cavities. Arms simple, more or less united by webs. Suckers prominent.

In the male, the hectocotylized arm is developed in a sac, the entire arm being modified, and usually, when perfected, it becomes detached from the body. Probably this arm is lost and regenerated each year.

### Parasira Steenstrup.

*Parasira* Kefferstein, in Bronn, Thier-Reich., iii, p. 1449, 1866.
Tryon, Man. Conch., i, p. 104.

Body short, thick, pouch-like, usually ornamented with raised ridges. Mantle united directly to the head dorsally; laterally connected to the base of the siphon by a pit and raised cartilaginous tubercle on each side, which fit corresponding pits and tubercles, near the base of the siphon (something as a button fits into a button-hole), so that it can be separated only with considerable diffi-

Gill-opening very wide, extending upward beyond the eyes. Arms long, slender; web rudimentary. Suckers prominent, in two alternating rows. Siphon large, intimately united to the whole length of the lower side of the head; its free extremity is situated far forward, between the ventral arms.

The sexes are widely different. The hectocotylized arm of the male is developed in a pedunculated sac.

There is a large aquiferous pore just behind the base of each ventral arm, at the sides of the siphon; these connect with large, cephalic, aquiferous cavities. The connective cartilages on each side of the base of the siphon consist of a prominent button, with an expanded and recurved anterior edge, which fits into a corresponding deep pit in the mantle-cartilage; and a deep, triangular pit, in front of the button, which receives the pointed, angular, cartilaginous tubercle of the mantle-cartilage. The posterior border of the base of the siphon forms a broad collar, within the mantle border. The lateral openings to the gill-cavity, on the sides of the neck, extend up as far as the upper side of the eyes; opposite and below the eyes, they are large, but internally are interrupted by two muscular bands on each side, one running back from the head to the mantle and one going back from the base of the siphon, opposite the connective cartilage.

The median septum of the gill-cavity is strong, but short, commencing a little behind the base of the siphon and extending only a short distance back, but expanding in length as it joins the ventral surface of the mantle; behind it the two halves of the gill-cavity are connected by a wide opening. The peritoneal membrane is strong, and specked with dark chromatophores.

### Parasira catenulata Steenstrup.

*Octopus tuberculatus* Risso (?), Hist. nat. de l'Eur. mérid., iv, p. 3, 1826 (t. d'Orb.)
*Octopus catenulatus* Férussac, Poulpes, pl. 6, bis, ter., 1828 (t. D'Orbig.)
*Philonexis tuberculatus* Fér. and D'Orb., Céph. Acét., p. 87, pl. 6, bis, ter.
*Parasira catenulata* Steenstrup.
Verrill, Amer. Journ. Sci., xix, p. 293, Apr., 1880.

PLATE XXXIII, FIGURES 2, 2*a*.

Female: Body relatively large, swollen, rather higher than broad, dilated below, larger in front, obtusely rounded posteriorly; upper surface smooth or finely wrinkled; lower surface covered with prominent, rounded verrucæ or small hard tubercles, which are connected together by raised ridges, five (sometimes six) of which usually run to each tubercle, thus circumscribing angular depressed areas, each

of which usually has a dark-colored spot in the center; on the sides, these tubercles are less prominent and less regular, gradually fading out above. The head is decidedly smaller than the body, and smooth both above and below. The eyes are prominent, but the external opening is small, round, with simple border. The gill-opening is large, and extends upward on the sides of the neck to the level of the upper sides of the eye-balls. The siphon-tube is completely united by its basal portion to the lower side of the head; its free portion is large and elongated, standing out well forward, between the bases of the ventral arms. There is a conspicuous aquiferous pore at each side of the base of the siphon, just back of the ventral arms. The arms are stout, not very long; the inner surface is broad, with two rows of rather widely separated suckers, which run along the margins of the arms; the suckers are rather large, and considerably raised on stout bases; the first suckers form a regular circle around the mouth; two or three basal suckers are nearly in a single row. The suckers are cup-shaped, with a deep central pit, around which there are strong radial ridges; toward the base of the arms the soft swollen rims of the suckers are wrinkled and lobulated; farther out they are smooth and even. The beak is black, with sharp tips. It is surrounded by a thick, wrinkled buccal membrane.

The arms are slightly united at their bases by a narrow web, which also runs along each of the outer angles of the six upper arms, forming more or less wide marginal membranes, according to the state of extension, and by their contractions causing the arms to curl in various directions; one of these membranes frequently disappears, if the other be so stretched as to become wide, when the arm is strongly recurved; on the ventral arms the upper membrane becomes strongly developed, while the lower one is abortive. There is also a slight marginal membrane along the inner margins, running between the suckers and connecting them together. The dorsal and ventral arms are considerably larger and longer than the two lateral pairs, the dorsal ones are the stoutest. The two lateral pairs are about equal in size and length. On the dorsal arms there are about 96 suckers; on the lateral ones about 80, that can be counted with the naked eye. The tips are very slender and covered with very minute suckers.

Color of the body and head, above, and of the upper arms, deep brownish purple; lower surfaces of body and head, with the siphon and ventral arms, pale yellowish.

The total length of our specimen is 203$^{mm}$; of mantle, 51; circum-

ference of body, 152; length of dorsal arms, from eye, 137; second pair, 94; of third pair, 84; of fourth pair, 134·5.

A specimen of this interesting species was taken in Vineyard Sound, Mass., by Mr. V. N. Edwards, in 1876. It was not known previously from the American coast, and has been regarded as peculiar to the Mediterranean and West Indies.

*Measurements of Parasira catenulata.*

| | | | Left Side. | |
|---|---|---|---|---|
| | mm. | inches. | mm. | inches. |
| From base of arms to tip of tail | 70 | 2·75 | | |
| From base of arms to mantle | 20 | ·80 | 81 | 3·2 |
| From edge of mantle to tip of tail | 51 | 2·00 | | |
| From edge of mantle to tip of tail (below) | 81 | 3·2 | | |
| Tail to eye | 66 | 2·60 | | |
| Circumference of body | 152 | 6·00 | | |
| Breadth of body | 51 | 2·00 | | |
| Circumference of head | 109 | 4·30 | | |
| Breadth of head | 38 | 1·50 | | |
| Diameter of eyes | 2·5 | ·10 | | |
| Diameter of largest suckers | 3·5 | ·14 | | |
| Length of dorsal arms, first pair, from eye | 134 | 5·30 | 109 | 4·30 |
| " " " second " " | 93 | 3·70 | 96 | 3·80 |
| " " " third " " | 92·5 | 3·68 | 89 | 3·50 |
| " " " fourth " ventral | 149 | 5·88 | 134 | 5·30 |
| Breadth of first pair of arms at base | 7·5 | ·30 | 8·75 | ·35 |
| " " second " " " | 7 | ·28 | 7 | ·28 |
| " " third " " " | 6·25 | ·25 | 6·25 | ·25 |
| " " fourth " " " | 7·5 | ·30 | 7·5 | ·30 |
| Length of siphon | 58 | 2·30 | | |
| Breadth of base of free part | 11·25 | ·45 | | |
| Breadth at tip | 7·5 | ·30 | | |

The remarkable tubercles of the ventral surface mostly have five ridges converging to each, rarely six. In all other respects it agrees with the figures of Férussac and D'Orbigny. According to Targioni-Tozzetti, *P. catenulata* is distinct from *P. tuberculata*. If so, our species should bear the former name.

## Family ARGONAUTIDÆ Cantr.

Cantraine, Mall. Médit., p. 13, 1841; H. & A. Adams, Genera, i, p. 23.
*Ocythoidæ* Gray, Catal. Moll. Brit. Mus., i, p. 28.

### Argonauta argo Linné.

Shells of this species, some of them entire, were taken by the "Fish Hawk" at several of the stations 70 to 115 miles south of Martha's Vineyard and Newport, R. I., in 64 to 365 fathoms. At least nine specimens were dredged. At Station 894, in 365 fathoms, two entire and nearly fresh shells were taken, and another

nearly complete. They belong to the common Mediterranean variety. Fragments were also taken at Stations 865–7, 871, 873, 876, 892, 895.

The capture of a living specimen, probably of this species, on the coast of New Jersey, has been recorded by Rev. Samuel Lockwood, Amer. Naturalist, xi, p. 243, 1877.

## Family ALLOPOSIDÆ Verrill, nov.

Body thick, obtusely rounded; arms extensively webbed; mantle-edge united directly to the head, not only by a large dorsal commissure, but also by a median-ventral and two lateral longitudinal commissures, which run from its inner surface to the basal parts of the siphon.

The male hectocotylized right arm of the third pair is developed in a cavity in front of the right eye and, when mature, protrudes from an opening on the inner surface of the web, between the second and fourth pairs of arms, and finally becomes detached. It is furnished with two rows of large suckers, and with a fringe along the sides. The mode of attachment of the mantle to the head is similar to that of *Desmoteuthis*, among the ten-armed cephalopods.

### Alloposus Verrill.

Amer. Journ. Sci., xx, p. 393, Nov., 1880; Proc. Nat. Mus., iii, p. 362, Dec., 1880; Bulletin Mus. Comp. Zool., viii, p. 112, March, 1881.

Allied, in some respects, to *Philonexis* and *Tremoctopus*. Body thick and soft, smooth; arms (in the male only seven) united by a web, extending nearly to the ends; the length of the arms decreases from the dorsal to the ventral ones; suckers sessile, simple, in two rows; mantle united firmly to the head by a ventral and two lateral muscular commissures, the former placed in the median line, at the base of the siphon; free end of the siphon short, well forward.

In the male, the hectocotylized right arm of the third pair is developed in a sac in front of the right eye (Plate L, figs. 1, 1*a*); as found in the sac, it is curled up and has two rows of suckers; the groove along its edge is fringed; near the end, the groove connects with a rounded, obliquely placed, broad, flat or slightly concave lateral lobe, with transverse wrinkles or plications on the inner surface; the terminal portion of the arm is a long fusiform process.

## Alloposus mollis Verrill.

Amer. Jour. Sci., xx, p. 394, Nov., 1880; Proc. Nat. Mus., iii, p. 363, 1880; Bulletin Mus. Comp. Zool., viii, p. 113, pl. 4, fig. 4; pl. 8, figs. 1–2*a*, March, 1881.

PLATE L, FIGS. 1, 1*a*, 2, 2*a*. PLATE LI, FIG. 4.

Body stout, ovate, very soft and flabby. Head large, as broad as the body; eyes large, their openings small. Arms rather stout, not very long, webbed nearly to the ends, the dorsal much longer than the ventral arms; suckers large, simple, in two alternating rows. Color deep purplish brown, with a more or less distinctly spotted appearance. Total length of a medium sized specimen, 160$^{mm}$; of body, to base of arms, 90$^{mm}$; of mantle, beneath, 50$^{mm}$; of dorsal arms, 70$^{mm}$; breadth of body, 70$^{mm}$. Other specimens are about one-third larger. The sexes scarcely differ in size.

One mature, detached, hectocotylized arm (Plate LI, fig. 4) was taken November 16. This has two rows of large, six or seven-lobed suckers, a very long fringe, composed of thin, flat, lacerate processes, along each side; the terminal process is fusiform, acute, and loosely covered with a thin, translucent membrane, beneath which the inner surface, bearing chromatophores, can be seen. Length of this arm, 200$^{mm}$; its breadth, 20$^{mm}$; length of terminal process, 30$^{mm}$; its diameter, 7$^{mm}$; diameter of largest suckers, 6$^{mm}$; length of fringe, 15$^{mm}$.

Taken by the "Fish Hawk," at Stations 880, 892, 893, 895, about 100 to 115 miles south of Newport, R. I., in 225 to 487 fathoms. Also, off the mouth of Chesapeake Bay, at Station 898, November 16, in 300 fathoms, by Lieut. Z. L. Tanner.

*Specimens examined.*

| Station. | Locality. | Fath. | When received. | Received from. | Specimens. |
|---|---|---|---|---|---|
| | OFF NEWPORT, R. I. | | | | |
| | N. lat. W. long. | | | | |
| 880 | 39° 48′ 30″ 70° 50′ 00″ | 252 | Sept. 13, 1880 | U. S. Fish Com. | 2 ♂ : 1 ♀ |
| 881 | Farther southward | 325 | Sept. 13, 1880 | do | 1 |
| 892 | 39° 46′ 00″ 71° 05′ 00″ | 487 | Oct. 2, 1880 | do | 1 |
| 893 | 39° 52′ 20″ 70° 58′ 00″ | 372 | Oct. 2, 1880 | do | 2 |
| 895 | 39° 56′ 30″ 70° 59′ 45″ | 238 | Oct. 2, 1880 | do | 1 |
| | OFF CHESAPEAKE BAY. | | | | |
| 898 | 37° 24′ 00″ 74° 17′ 00″ | 300 | Nov. 16, 1880 | do | 4 |

## Family OCTOPODIDÆ D'Orbigny, (restricted).

*Octopodidæ* (*pars*) D'Orbigny, Moll. Viv. et Fos., i, 159, 164, 1845 (t. Gray); (*pars*) Céphal. Acétab., p. 3.
*Octopidæ* (*pars*) Gray, Catal. Moll. Brit. Mus., i, p. 4, 1849.

Body short, thick, rounded posteriorly, destitute of lateral fins and internal cartilages. Mantle united to the head by a broad dorsal commissure. Head very large. Connection between the mantle and base of siphon simple, without cartilages. Opening to the gill-cavity narrow. Median septum of branchial cavity short, extending forward to the base of the siphon, but running back only a short distance. Siphon large, simple. Arms with either one or two rows of suckers, and with a more or less developed basal web. No cephalic aquiferous pores. Eyes furnished with an internal translucent lid, and also capable of being covered with the external integument. Sexes similar externally, except that the right arm of the third pair in the male is hectocotylized by the formation of a spoon-shaped organ at the tip.

### OCTOPUS Lamarck, 1799.

*Octopus* (*pars*) Lamarck, Syst. des Anim. sans Vert., p. 60, 1801.
Cuvier, Rég. Anim., ii, 1817.
D'Orbigny, Céphal. Acétab., p. 3.
Gray, Catal. Moll. Brit. Mus., i, p. 4, 1849.

Body short, thick, more or less rounded, usually flattened, often tubercular or warty, but sometimes smooth, usually with one or more tubercles or cirri situated above the eye. Mantle directly united to the head, dorsally, by a broad commissure, extending below the eyes to the base of the siphon. Base of the siphon without any complicated connective cartilages. Arms united by a more or less extensive basal web. Suckers sessile, in two alternating rows. Siphon not intimately united to the whole length of the under side of the head, the free terminal portion situated behind or beneath the eyes. No aquiferous pores, nor brachial pouches.

The sexes are similar in form. In the male the right arm of the third pair is hectocotylized, its terminal portion being changed into a spoon-shaped organ, smooth on the outer convex side and furnished with a series of transverse ridges on the inner concave side, and with a basal angular lobe from which a groove or furrow extends along the lower margin of the arm to the basal web. In some species of *Octopus* this modified tip is very small, but in others very large.

The female has oviducts on both sides. Eggs comparatively few

and large, elongated pyriform, attached singly or in clusters by the small end.

In addition to the several small species described here, a much larger rough-backed species has been taken several times at Fort Macon and near Beaufort, N. C. This is probably *Octopus rugosus* Bosc, a West Indian species.

### Octopus Bairdii Verrill.

*Octopus Bairdii* Verrill, Amer. Jour. Sci., v, p. 5, Jan., 1873; xix, p. 294, 1880; American Naturalist, vii, p. 394, figs. 76, 77, 1873; Am. Assoc. Adv. Sci. for 1873, p. 348, pl. 1, figs. 1, 2, 1874.

G. O. Sars, Mollusca Regionis Arcticæ Norvegiæ, p. 339, pl. 33, figs. 1–10 (♀), pl. xvii, figs. 8*a* to 8*d* (dentition and jaws), 1878.

Tyron, Man. Conch., i, p. 116, pl. 32, figs. 37, 38 (description and figures from the papers by A. E. V.).

Verrill, Bulletin Mus. Comp. Zool., viii, p. 107, pl. 2, figs. 4, 4*a*; pl. 4, figs. 1, 1*a*, 1881.

PLATE XXXIII, FIGS. 1, 1*a*. PLATE XXXIV, FIGS. 5, 6. PLATE XXXVI, FIG. 10. PLATE XXXVIII, FIG. 8; PLATE XLIX, FIGS. 4, 4*a*; PLATE LI, FIGS. 1, 1*a*.

The body is short, thick, somewhat depressed, broadly rounded posteriorly, separated from the head only by a slight constriction at the sides. Head almost as broad as the body, swollen above and around the eyes, concave in the middle above; around the eyes, and especially in front and above, there are numerous small, conical, often irregular and rough tubercles; a little removed from the upper side of each eye, is a much larger, rough, irregularly conical, erectile cirrus, which has some small, more or less prominent, conical papillæ on its surface; the whole upper surface of the body, head, and arms is also covered with minute scattered papillæ, which are usually but little prominent, but in some of the larger males they become much larger and more numerous, and have the form of small prominent warts.

The jaws (Plate XLIX, fig. 4*a*) have rather blunt, slightly incurved tips, with the angle at the bases of the cutting edges round and without any distinct notch. The odontophore, (Plate XLIX, fig. 4) has a median row of large, acute teeth, with broad bases without lateral denticles; the inner lateral teeth are much smaller, with curved acute-triangular points; outer lateral teeth longer and more acute; marginal plates large and distinct.

Siphon large, tapering, capable of being bent in all directions, so as to be used for swimming either forward, backward, or sideways, according to its direction.

Arms subequal, relatively short, stout, tapering to slender points, connected for about one-third of their length by a web, which extends as a narrow membrane along their margins to near the ends. Suckers small, not crowded, alternating pretty regularly in two rows; in the original type-specimen, which was not full grown, the arms of the first pair each had about sixty-five suckers; those of the fourth pair about sixty. In a large example (♀) the dorsal arms have about 94; third pair about 100; fourth pair about 90.

In the male, the right arm of the third pair has its terminal portion, for about a third of its entire length, modified for reproductive purposes into a large spoon-shaped organ (Plate XXXIII, figs. 1, 1*a*, *h*), broadly elliptical in outline, with the sides incurved and the end somewhat tri-lobed; its interior deeply concave with ten to twelve, and occasionally, in the largest examples, thirteen, elevated transverse folds; at the base, there is a fold bent into an acute angle, the apex directed forward, leaving a deep V-shaped sinus behind it, which is a continuation of a shallow groove formed by a thickening of the web along the lower side of the arm, and terminating midway between it and the fourth arm. At the end, this arm terminates in a small conical tip, between the two broadly rounded lobes of the spoon-shaped organ; at the base of this organ there is a slight constriction; the basal portion of the arm bears 30 to 37 suckers, like those on the other arms. The modified portion of the arm is considerably longer than the distance between the constriction at its base and the interbrachial web, and about equal to one-half the total length of the part which bears suckers. The corresponding arm on the left side is of the ordinary form and has, in a medium sized example, about fifty-one suckers. The female differs but little from the male, externally, except in lacking the modification of the third right arm.

Length of the original male specimen, in alcohol, exclusive of the arms, $44^{mm}$; breadth of the body, $31^{mm}$; between eyes, $18^{mm}$; length of the arms, of the first pair, from mouth, $18^{mm}$; from mouth to edge of the web, $57^{mm}$; length of modified portion of third right arm, $18^{mm}$; breadth of this organ when expanded, $11{\cdot}5^{mm}$. Subsequently somewhat larger specimens, both male and female, have been taken.

One of the largest males (Station 878) measures from tip of dorsal arms to end of body, $163^{mm}$; from edge of dorsal web to end of body, $75^{mm}$; from edge of mantle, beneath, to end of body, 38; breadth of body, 48; of head, 41; length of dorsal arms to beak, 110; of second pair, 112; of third pair, 115; of fourth pair, 110; of hectocotylized arm, 85; length of terminal spoon, 33; its breadth, 17. This specimen has thirteen transverse lamellæ in the spoon.

One of the largest females (Station 895,) in breeding season and filled with eggs, measures, from tip of dorsal arms to end of body, 170$^{mm}$; edge of dorsal web to end of body, 90; mantle, beneath, 46; breadth of body, 55; of head, 41; length of dorsal arms from beak, 125; of second pair, 120; of third pair, 115; of fourth pair, 115$^{mm}$.

When living, the ground-color was usually pale, translucent, bluish white, above thickly specked with light orange-brown and dark purplish brown. Its colors were changeable, but apparently less actively so than in the squids.

The spermatophores (Pl. XXVI, fig. 10, A, B) are remarkably large in proportion to the size of the animal, being from 50 to 75$^{mm}$ in length and 4 to 5$^{mm}$ in diameter. The form is club-shaped, with the narrow portion little longer than the thickened part. They are almost perfectly transparent, and the milk-white, coiled string of spermatozoa can be plainly seen in the interior. There is a slender, thread-like filament at each end, that of the small end much the longest. When they begin to discharge their contents (as in fig. 10, A), the form changes rapidly. In several instances I have observed these spermatophores escaping from the siphon of recently captured specimens, taken at various dates, from July 23 to Sept. 21, at stations 138, 161, 163, 223, etc.

This species was first discovered by the writer, while dredging in 1872, on the U. S. steamer "Mosswood," in the Bay of Fundy, off Eastport, Me., in 75 to 80 fathoms. Although so recently discovered, it proves to have a very extensive range, both geographically and in depth. It is one of the most common and characteristic inhabitants of the bottom, in 100 to 500 fathoms, along our entire coast, from South Carolina to Newfoundland. It was taken in the trawl, by the U. S. Fish Commission, in 1872, 1873, 1874, 1877, 1878, 1879, and 1880, in depths ranging from 50 to 500 fathoms, at numerous localities, from off Halifax, N. S., and in the Bay of Fundy, to the region 90 to 100 miles south of Newport, R. I., where it is common and of large size. It was obtained by Mr. A. Agassiz, on the "Blake," in 1880, at various stations, from N. lat. 41° 34′ 30″, to 32° 43′ 25″, in 178 to 524 fathoms.

In November, 1880, it was taken by Lieut. Z. L. Tanner, on the "Fish Hawk," off the mouth of Chesapeake Bay, in 157 to 300 fathoms.

The Gloucester fishermen have brought in several specimens from the banks off Nova Scotia and Newfoundland.

Professor G. O. Sars has taken it off the Norwegian coast, in 60 to 300 fathoms.

It occurs both on soft muddy bottoms and on hard bottoms. Both sexes often occur together, but the males are usually the most numerous.

Recently hatched young have been taken in August and September, in the Bay of Fundy, off Halifax, N. S., and off Cape Ann, Mass. (at stations 45, 85, 234, 238, etc.).

One of the specimens obtained by Mr. Agassiz is remarkable for the length and slenderness of the cirrus above the eyes (Plate LI, fig. 1, 1*a*). This is an immature male, and does not appear to differ in any other way from ordinary specimens, of similar size. The appendage of the hectocotylized arm is small and not fully developed (as is always the case in young males), and has an ovate-triangular form, a slightly concave surface, and only a few transverse lamellæ.

*Octopus Bairdii.—Specimens examined.*

| Stat. | Locality. | Fath. | Bottom. | When coll'd. | Specimens. No. Sex. |
|---|---|---|---|---|---|
| | *U. S. Fish Com.* | | | | |
| | Bay of Fundy | 75 | ---- | 1872 | 2 ♂ : 1 j. ♀ |
| | Bay of Fundy | 80 | ---- | 1872 | 1 l. ♂ |
| | Bay of Fundy | 60 | ---- | 1872 | 1 ♂ |
| | Off G. Menan I. | 97–110 | gravel | 1872 | 2 j. ♂ |
| | Casco Bay | 64 | ---- | 1873 1877 | 1 med. |
| 30,31, 32, 33 | Gulf of Maine, off Cape Ann | 90 | mud | Aug. 14 | 2 l. ♂ : 2 juv. 5 ♂ |
| 45 | Off Cape Sable, 30 m. | 91 | fine sand | Aug. 21 | 1 l. ♂ : 4 j. ♂ : 4 j. ♀ |
| 85, 86 | Off Halifax, 23 m. | 101 | fine sand | Sept. 6 | 2 ♂ : 2 l. ♂ : 4 ♀ |
| | *Gulf Maine and Mass. Bay.* | | | | |
| | Off Gloucester, Mass. | | | 1878 | |
| 130 | S. of Cape Ann, 13 m. | 49 | mud | July 23 | 1 ♂ |
| 138 | Off Cape Ann, 9 m. | 59 | muddy | July 29 | 1 j. ♂ : 2 l. ♂ : 2 ♀ |
| 156 | Off Cape Ann, 5½ m. | 42 | mud | Aug. 15 | 1 j. |
| 161 | Off Cape Ann, 6 m. | 54 | sand | Aug. 16 | 1 l. ♂ : 1 j. ♂ : 1 j. ♀ |
| 163 | Off Cape Ann, 6½ m. | 73 | fine sand | Aug. 16 | 5 j. ♂ : 3 l. ♂ : 1 j. ♀ |
| 164 | Off Cape Ann, 7 m. | 75 | fine sand | Aug. 16 | 2 ♂ : 3 j. ♂ : 2 l. ♀ : 3 |
| 182 | South of Gloucester | 45 | ---- | Aug. 29 | 4 j. ♀ [j. ♀ |
| 199 | Off Cape Ann, 13½ m. | 58 | muddy | Sept. 2 | 1 j. ♂ : 2 l. ♂ : 1 l. ♀ : 2 |
| 184 | Off Gloucester, Mass., 4½ m. | 45 | mud | Aug. 29 | 3 j. ♀ : 1 j. ♂ [j. ♀ |
| 207 | Off Gloucester, Mass., 4¾ m. | 42 | soft mud | Sept. 16 | 1 j. ♂ |
| 211 | Off Cape Ann, 6 m. | 60 | mud | Sept. 17 | 4 j. ♂ : 2 j. ♀ : 1 ♀ |
| 213 | Off Cape Ann, 5½ m. | 68 | mud | Sept. 17 | 1 l. ♂ |
| 214 | Off Cape Ann, 6 m. | 57 | fine sand | Sept. 17 | 1 m. ♀ |
| 223 | Off Cape Ann, 7 m. | 47 | soft mud | Sept. 21 | 2 ♂ : 1 ♀ : 1 l. ♀ |
| 233 | South of Gloucester, 4¾ m. | 45 | soft mud | Sept. 24 | 1 j. ♂ |
| 234 | South of Gloucester | 43 | soft mud | Sept. 24 | 2 j. ♂ : 1 j. ♀ |
| 238 | Off Gloucester, 4½ m. | 43 | soft mud | Sept. 26 | 2 ♀ |

*Octopus Bairdii—Continued.*

| Stat. | Locality. | Fath. | Bottom. | When coll'd. | Specimens. No. Sex. |
|---|---|---|---|---|---|
| | | | | 1879 | |
| 264 | Off Cape Cod, 15 m. | 80 | mud | July 29 | 2 j. ♂ : 1 l. ♀ : 1 j. ♀ |
| 342 | Off Cape Cod, 14 m. | 94 | mud | Sept. 10 | 2 m. ♂ : 1 j. ♀ |
| 364 | Off Cape Cod, 15 m. | 70 | hard sand | Sept. 18 | 3 l. ♂ : 2 j. ♂ : 2 l. ♀ |
| 372 | Off Chatham, Mass., 21 m. | 70 | sand | Sept. 19 | 1 l. ♀ |
| | *Off Newport, R. I.* | | | | |
| | N. Lat. W. Long. | | | 1880 | |
| 869 | 40° 02′ 18″ ; 70° 23′ 06″ | 192 | mud, fine sand | Sept. 4 | 1 l. ♀ : 3 j. ♀ |
| 870 | 40 02 36 ; 70 22 58 | 155 | fine sand | Sept. 4 | 1 l. ♂ : 3 j. |
| 874 | 40 ; 70 57 | 85 | mud | Sept. 13 | 1 |
| 878 | 39 55 ; 70 54 15 | 142½ | mud | Sept. 13 | 1 l. ♂ |
| 879 | 39 49 30 ; 70 54 | 225 | fine sand | Sept. 13 | 1 ♂ : 1 ♀ |
| 880 | 39 48 30 ; 70 54 | 252½ | mud | Sept. 13 | 1 ♂ : 1 ♀ |
| 892 | 39 46 ; 71 05 | 487 | mud | Oct. 2 | 1 l. ♀ |
| 893 | 39 52 20 ; 70 58 | 372 | mud | Oct. 2 | 2 ♂ : 2 ♀ |
| 894 | 39 53 ; 70 58 30 | 365 | sand | Oct. 2 | 3 l. ♂ : 3 ♀ |
| 895 | 39 56 30 ; 70 59 45 | 238 | mud | Oct. 2 | 2 ♂ : 2 ♀ |
| | *Off Chesapeake Bay.* | | | | |
| 897 | 37 25 ; 74 18 | 157½ | sand | Nov. 16 | 1 ♂ |
| 898 | 37 24 ; 74 17 | 300 | mud | Nov. 16 | 2 ♂ : 4 ♀ |
| | *Blake Exp.—U. S. Coast Survey.* | | | | |
| | N. Lat. W. Long. | | | | |
| 303 | 41° 34′ 30″ ; 65° 54′ 30″ | 306 | ---- | 1880 | 1 ♂ (fig'd) |
| 332 | 35 45 30 ; 74 48 | 263 | ---- | 1880 | 4 ♂ : 1 j. ♀ |
| 327 | 34 0 30 ; 76 10 30 | 178 | ---- | 1880 | 1 ♂ : 1 ♀ |
| 310 | 39 59 16 ; 70 18 30 | 260 | ---- | 1880 | 1 ♂ |
| 336 | 38 21 50 ; 73 32 | 197 | ---- | 1880 | 1 ♂ j. |
| 321 | 32 43 25 ; 77 20 30 | 233 | ---- | 1880 | 1 ♂ : 1 ♀ j. |
| 306 | 41 32 50 ; 65 55 | 524 | ---- | 1880 | 1 ♂ j. |
| Lot. | *Gloucester Fisheries.* | | *Schooner.* | | |
| 264 | Lat. 42° 49′ ; long. 62° 57′ | 200–300 | Marion | Jan. '79 | 1 l. ♀ |
| 351 | N.lat. 44° 17′ ; W.long. 58° 10′ | 120 | Grace L. Fears | June '79 | 2 ♀ |
| 372 | Off Miquelon I. | 7 | A. M. Williams | July '79 | 1 |
| 421 | Banquereau, off N. S. | 300 | Commonw'lth | Aug. '79 | 1 ♀ |
| 501 | N. lat. 43° 14′ ; long. 61° 7′ | 250 | A. M. Williams | Oct. '79 | 1 ♀ |
| 605 | Brown's Bank, N. S. | --- | Barracouta | Jan. '80 | 1 mutilated |
| 771 | Off St. Peter's Bank | 80 | Epes Tarr | July '80 | 1 ♂ : 1 ♀ |
| 792 | | --- | G. P. Whitman | Aug. '80 | 1 l. ♂ |
| 917 | Banquereau, N. S. | --- | A. M. Williams | 1880 | 1 l. ♂ |
| 721 | Grand Bank | --- | GuyC'ningham | July '80 | 1 l. ♀ |

In the last column, *j.* = young; *l.* = large; *m.* or *med.* = medium size.

Specimens of this species were kept alive for several days, in order to observe its habits. Several characteristic drawings, three of which are now reproduced (Plate XXXIV, figs. 5, 6; Plate XXXVIII, fig. 8), were made from life by Mr. J. H. Emerton, showing its different attitudes.

When at rest it remained at the bottom of the vessel, adhering firmly by some of the basal suckers of its arms, while the outer portions of the arms were curled back in various positions; the body was held in a nearly horizontal position, and the eyes were usually half-closed and had a sleepy look; the siphon was usually turned to one side, and was long enough to be seen in a view from above.

When disturbed, or in any way excited, the eyes opened more widely, especially at night; the body became more contracted and rounded, and was held more erect; the small tubercles over its surface and the larger ones above the eyes were erected, giving it a very decided appearance of excitement and watchfulness.

It was rarely, if ever, observed actually to creep about by means of its arms and suckers, but it would swim readily and actively, circling around the pans or jars, in which it was kept, many times before resting again.

In swimming backward the partial web connecting the arms together was used as an organ of locomotion, as well as the siphon; the arms and web were alternately spread and closed, the closing being done energetically and coincidently with the ejection of the water from the siphon, and the arms after each contraction were all held pointing straight forward in a compact bundle, so as to afford the least resistance to the motion (fig. 8). As the motion resulting from each impulse began to diminish sensibly, the arms were again spread, and the same actions repeated. This use of the arms and web recalled that of the disk of the jelly-fishes, but it was much more energetic.

The siphon was bent in different directions to alter the direction of the motions, and by bending it to the right or left side, backward motions in oblique or circular directions were given, but it was often bent directly downward and curved backward, so that the jet of water from it served to propel the animal directly forward. This, so far as observed, was its only mode of moving forward. The same mode of swimming forward has been observed in cuttle-fishes (*Sepia*) and in squids (*Loligo*).

This species was much more active and animated in the night than during the day, and is probably largely nocturnal in its habits, when at liberty. None of the specimens could be induced to take food, and none survived more than four or five days, although the water was frequently renewed to keep it cool and pure. They had been rather roughly handled by the dredges and trawls, without doubt. But the unavoidable exposure to the higher temperature of the water, near and

*Measurements of northern species of Octopus (in inches).*

| Name. | *O. piscatorum* ♀. | | *O. lentus* ♀. | | *O. obesus* ♂. | | *O. Bairdii.* | | |
|---|---|---|---|---|---|---|---|---|---|
| Right or left side. | Left. | Right. | Left. | Right. | Left. | Right. | ♂. | ♂. | ♀. |
| Total length, to tip of arms, 1st pair | 6·20 | 5·80 | 7·48 | 7·76 | 7·90 | 8·50 | 2·50 | 6·25 | 7·00 |
| Total length, to tip of arms, 2d pair | 6·30 | 5·00 | 7·12 | 7·40 | 7·98 | 7·98 | 2·40 | 6·20 | 6·50 |
| Total length, to tip of arms, 3d pair | 5·75 | 5·30 | 7·52 | 7·76 | 7·86 | 6·90 | 2·45 | 5·50 | 6·40 |
| Total length, to tip of arms, 4th pair | 5·25 | 5·00 | 7·16 | 6·94 | 7·10 | 7·46 | 2·50 | 5·25 | 6·25 |
| Length to web between dorsal arms | 3·25 | -- | -- | -- | 4·40 | -- | 1·35 | 3·96 | 2·55 |
| Length to edge of mantle (beneath) | 1·20 | -- | 2·40 | -- | 1·96 | -- | -- | 1·50 | 1·82 |
| Length to center of eye | 1·55 | -- | -- | -- | 2·88 | -- | -- | 1·50 | 2·00 |
| Breadth of body, in middle | 1·25 | -- | 1·60 | -- | 1·84 | -- | ·95 | 1·90 | 2·17 |
| Breadth of head (across eyes) | 1·20 | -- | 1·28 | -- | 1·52 | -- | ·85 | 1·62 | 1·62 |
| Breadth of arms, near base | ·22 | -- | ·30 | -- | ·32 | -- | -- | ·28 | ·35 |
| From beak to web, between dorsal arms | 1·10 | -- | -- | -- | -- | -- | -- | 1·00 | 1·35 |
| Length of spoon of hectocotylized arm | -- | -- | -- | -- | -- | 1·40 | ·30 | 1·30 | -- |
| Its breadth | -- | -- | -- | -- | -- | ·64 | ·15 | ·68 | -- |
| Rest of arm, to beak | -- | -- | -- | -- | -- | 2·60 | -- | 2·25 | -- |
| Length of dorsal arms, from beak | 4·25 | 4·00 | 4·20 | 4·48 | -- | -- | -- | 4·25 | 4·95 |
| Length of 2d pair arms, from beak | 4·35 | 3·20 | 3·84 | 4·12 | -- | -- | -- | 4·35 | 4·60 |
| Length of 3d pair arms, from beak | 3·85 | 3·75 | 4·24 | 4·48 | -- | -- | -- | 4·00 | 4·35 |
| Length of 4th pair arms, from beak | 3·15 | 3·20 | 3·88 | 3·76 | -- | -- | -- | 3·85 | 4·15 |

at the surface, especially in summer, is sufficient to kill many of the deep-water animals, while others that live for a short time never recover entirely.

This species resembles *O. lentus*, but has a much larger and rough or lacerate cirrus above the eye. The modified arm of the male is also different. It is somewhat related to *O. Grœnlandicus* Dewh., but the male of the latter has the third right arm much longer, with the modified spoon-shaped portion relatively very much smaller and quite different in form, and with more numerous folds, and the basal part bears 41 to 43 suckers; the other arms also have more numerous suckers; the web is less extensive and the body is more elongated and appears to be smooth and destitute of the large cirrus above the eyes, if correctly figured.

*O. obesus* has the spoon-shaped part of the third right arm relatively larger, and several of the basal suckers of the other arms are in a single row. It also differs in other respects.

### Octopus lentus Verrill.

Verrill, Amer. Jour. Sci., xix, p. 138, Feb., 1880; p. 294, April, 1880; Bulletin Mus. Comp. Zool., viii, p. 108, pl. 4, fig. 2, ♂.

PLATE XXXV, FIGURES 1, 2, ♀. PLATE LI, FIGURE 2, ♂.

Female (type specimen): Body broad, stout, depressed, slightly emarginate at the posterior end, rather soft to the touch, and in some specimens gelatinous in appearance; a thin, soft, free, marginal membrane runs along the sides and around the posterior end of the body, becoming widest (about 12$^{mm}$) posteriorly; in some of the more strongly contracted specimens this membrane is but little apparent. Head large, broad, depressed, with the eyes large and far apart; above each eye there is a small, simple, conical, acute, contractile cirrus. A well-developed thin web connects the arms, considerably above their bases, and then runs up to the tips as broad margins to each arm.

The arms are rather large, stout at base, with a broad inner face, and taper gradually to very slender tips; the first and third pairs are nearly equal in length; those of the second are also about equal in length to the fourth pair, but are somewhat shorter than the first and third. The arms on the right side, in the type-specimen, were all somewhat longer than the corresponding ones on the left. The arms, measuring from the beak, are more than twice as long as the body. The suckers are arranged in two distinct rows, to the base.

Color of head and body above, and of body beneath, deep reddish

brown, closely specked with darker brown, and with many small roundish spots of whitish on the body and arms.

Length of the type-specimen (♀) from the beak to the end of the body, not including the marginal web, 60$^{mm}$; breadth of web, 22; total length, 194; breadth of body, 40; breadth of head, across eyes, 32; of eye-openings, 10; of eye-balls, 17; length of mantle, beneath, 38; length of arms of first pair, 112 and 105; of second pair, 103 and 96; of third pair, 112 and 106; of fourth pair 94 and 97; breadth of those of the three upper pairs, 8; of the ventral pair, 7$^{mm}$.

Male: Body depressed, rounded posteriorly, with only a trace of the lateral and posterior fold; surface soft and nearly smooth, but showing a small number of minute white papillæ sparsely scattered over the dorsal surface. Cirrus above the eye small and simple, usually contracted into a small, wart-like papilla. Head broad and flattened; eyes large. Arms rather long and slender, with slender tapering tips, their bases united by a rather wide web. Suckers small, very prominent, forming two regular rows, quite to the base.

The first two pairs of arms are nearly equal and somewhat longer than the two lower pairs, which differ but little between themselves. The hectocotylized arm (third of right side) bears thirty-five suckers, in two rows, and a remarkably large, terminal spoon-shaped organ, which occupies more than a third of the total length of the arm; its sides are bent up and the edges inrolled, so as to form a deep cavity; its outer end is broadly rounded laterally, and terminates in a central, narrow, acute lobe; internally there are nine large, high, oblique lamellæ, with deep fossæ between them; the proximal end has a large, acute, triangular lobe, with involute margins; from this lobe a broad groove runs along the lower edge of the arm to the margin of the web; where it terminates there is a distinct thickening of the bounding membrane.

The two males of this species, described above, were dredged by Mr. A. Agassiz, on the "Blake," in 1880, in 464 and 603 fathoms. They agree well in the peculiar characters and large size of the appendage of the hectocotylized arm. The females, only, were previously known. Although these males have a mere trace of the loose membranous fold of skin, along the sides and around the posterior end, so conspicuous in the original female specimen of this species, they agree so well in other characters that I unite them without much hesitation. It is probable that the presence or absence of the membranous fold, in this and other species, may be due merely to differences in the state of contraction when they die, or even to differences in the strength of the alcohol.

*Measurements in millimeters.*

| | ♂ Right Side. | ♂ Left Side. | ♀ Right Side. | ♀ Left Side. |
|---|---|---|---|---|
| Total length | 95 | -- | 194 | -- |
| Posterior end to center of eye | 34 | -- | -- | -- |
| Eye to tip of dorsal arms | 64 | -- | -- | -- |
| Breadth of body | 28 | -- | 40 | -- |
| Breadth of head | 22 | -- | 32 | -- |
| Length of dorsal arms, from mouth | 65 | 61 | 112 | 105 |
| " second pair " | 61 | -- | 103 | 96 |
| " third " " | -- | 52 | 112 | 106 |
| " hectocotylized arm, from mouth | 58 | -- | -- | -- |
| " fourth pair | -- | 53 | 94 | 97 |
| " spoon-shaped appendage | 23 | -- | -- | -- |
| Breadth of the same | 16 | -- | -- | -- |

The first specimen of this species was taken off Nova Scotia, near Le Have Bank, in 120 fathoms, by Captain Samuel Peeples and crew of the schooner "M. H. Perkins," and presented to the U. S. Fish Commission. A few others have since been brought in by the Gloucester fishermen, from the Bank Fisheries. Mr. A. Agassiz, dredged it on the "Blake," in 1880, as far south as N. lat. 33° 42′ 15″. It ranges in depth from 120 to 602 fathoms.

*Specimens examined.*

| No. | Stat. | Locality. | Fath. | When coll'd. | Specimens. No. and Sex. |
|---|---|---|---|---|---|
| 7 | 326 | N. Lat. 33° 42′ 15″; W. Long. 76° 0′ 50″ (Blake) | 464 | 1879 | 1 ♂: 1 ♀ |
| 10 | 329 | N. Lat. 34° 39′ 40″; W. Long. 75° 14′ 40″ (Blake) | 603 | 1879 | 1 ♂ (fig'd.) |
| | 553 | Le Have Bank, N. S. (sch. M. H. Perkins) | 120 | 1879 | 1 ♀ (fig'd.) |
| | 718 | S. of Newfoundland (sch. Proctor Brothers) | 150 | Jn '80 | 1 sm. ♀ |
| | 737 | St. Peter's Bank (sch. Augusta H. Johnson) | 200 | 1880 | 11. ♀ |
| | 807 | Banquereau (sch. Epes Tarr) | | Au. '80 | 1 ♀ |
| | 808 | N. Lat. 44° 32′; Gr. Bank (sch. Guy Cunningham) | | Au. '80 | 1 ♀ |

In the soft consistency of the flesh and skin, this species resembles *O. obesus*. It differs in the shorter and posteriorly emarginate body, and especially in the arrangement of the suckers, which, in that species, are in a single series toward the bases of the arms.

### Octopus piscatorum Verrill.

Verrill, Amer. Jour. Sci., vol. xviii, p. 470, Dec., 1879; xix, p. 294, Apr., 1880.

PLATE XXXVI, FIGURES 1, 2, ♀.

The body of the female is smooth, depressed, about as broad as long; rounded posteriorly, not showing any lateral ridges, nor dorsal papillæ; a small simple papilla above the eyes. Arms long, rather slender, tapering to long, slender, acute tips, the upper ones a little (2·5$^{mm}$) shorter than those of the second pair, which are the longest;

those of the third pair are about 12$^{mm}$ shorter than those of the second; the ventral pair about 6$^{mm}$ shorter than those of the third. In our type-specimen, all the arms on the right side are somewhat shorter than those on the left, and the web between the first and second arms is narrower, due, perhaps, to recovery from an injury. The web between the arms, except ventrally, is of about equal width, and scarcely more than one-fourth the length of the arms, measuring from the beak. Between the ventral arms the web is about half as wide as between the lateral.

The suckers are moderately large, decidedly prominent, alternating in two regular rows, except close to the mouth, where a few stand nearly in a single line; about fourteen to sixteen are situated on the part of the arms included within the interbrachial web. The whole number of suckers on one arm is upwards of seventy.

Color of one alcoholic specimen is deep purplish brown, due to very numerous crowded minute specks; eye-lids, whitish. The front border of the mantle, beneath, and the base of the siphon and adjacent parts are white; end of siphon, brown. Lower side of head and arms lighter than the dorsal side.

Total length, from posterior end of body to tip of arms, of 1st pair, 158$^{mm}$; 2d pair, 160$^{mm}$; 3d pair, 146$^{mm}$; 4th pair, 133$^{mm}$; to web between dorsal arms, 82$^{mm}$; between ventral arms, 63$^{mm}$; to edge of mantle, beneath, 30$^{mm}$; to center of eye, 39$^{mm}$. Breadth of body, 31$^{mm}$; of head across eyes, 30$^{mm}$; breadth of arms, at base, 5·5$^{mm}$; diameter of largest suckers, 2·5$^{mm}$; length of arms beyond web, 1st pair, 76$^{mm}$; 2d pair, 82$^{mm}$; 3d pair, 71$^{mm}$; 4th pair, 69$^{mm}$.

Two specimens of this species, both females, have been obtained. The first was from Le Have Bank, off Nova Scotia, in 120 fathoms, taken by Captain John McInnis and crew, of the schooner "M. H. Perkins," October, 1879; the second was taken by Captain David Campbell and crew, of the schooner "Admiral," (lot 590), near the Grand Bank, N. lat. 44° 07′; W. long. 52° 40′, in 200 fathoms, December, 1879.

This species resembles *O. Grönlandicus*, of which only the males appear to have been described, and it may eventually prove to be the female of that species.

This species is easily distinguished from *O. Bairdii*, by its more elongated body, its much longer and more slender and tapered arms, with shorter webs; by the absence of the large, rough, pointed papilla, or cirrus, above the eye, and by its general smoothness. The white color of the underside of the neck, siphon and mantle-border also appears to be characteristic.

**Octopus obesus** Verrill.

Verrill, American Jour. Sci., vol. xix, p. 137, Feb., 1880; vol. xix, p. 294, Apr., 1880.

PLATE XXXVI, FIGURES 3, 3*a*, ♂.

Male: Remarkable for the great size of the spoon-shaped organ of the right arm of the third pair. Body relatively large, stout, oblong-oval, somewhat flattened above, obtusely rounded at the posterior end; soft and somewhat gelatinous in texture; skin, so far as preserved, smooth, soft. No cirrus exists above the eye, in our specimen, but the skin is not so well preserved in that region as to render it certain that a small one may not have existed in life. Eyes very large.

Arms moderately long, the dorsal longest, others successively shorter; all somewhat laterally compressed at base, tapering to long, slender tips; a moderately developed web connects them together at base. The hectocotylized arm (third of right side), bears at the end a very large, broad and thick, but not very deep, spoon-like organ, occupying more than a third of the total length of the arm; its inner surface is crossed by eleven oblique, thick, rounded folds or ribs, ten of them converging backward to the median line and at their outer ends joining a marginal thickening. The distal end terminates in a median, pointed lobe, or tip, with a thin, rounded, lateral lobe each side of it; the proximal border is formed by the last (eleventh) fold, which is V-shaped, with the apex pointing distally. A broad, thin, marginal membrane extends along the lower side of the arm, from the terminal organ to the base. The suckers have been partly detached from this arm.

The suckers of all the arms are moderately large, nearly globular in form, rather numerous; the first six to ten, at the base, are nearly in one line, except on the left arm of the second pair, and appear to form only a single row; in this part the inner face of the arm is narrow, most so on the right arm of the second pair, and least on the left arm of the same pair; farther out this face becomes broader and the suckers are in two distinct rows. The suckers are destroyed on the distal portion of all the arms.

The color of the body and arms is mostly destroyed, but so far as preserved, is pale pinkish, more or less thickly specked with distinct reddish brown spots, most conspicuous at the base of the arms and above the eyes, (elsewhere the color is probably not so well preserved).

Length of body, from the posterior end to the base of arms, 82$^{mm}$; to center of eye, 72; to edge of mantle, beneath, 49; to tip of right

dorsal arm, 213; left, 198; to tips of second pair, 200; to tip of right arm of third pair, 173; of left, 197; to tip of right, of fourth pair, 187; of left, 178; to edge of web, 110; breadth of body, in middle, 46; breadth of head, across eyes, 38; breadth of dorsal arms, at base, 8; diameter of largest suckers, 3; length of spoon-shaped end of right arm of third pair (hectocotylized), 35; breadth, 16; length of rest of arm, to mouth, 65mm.

Taken from the stomach of a halibut, 36 miles east from the N. E. Light of Sable Island, in 160 to 300 fathoms, by Charles Ruckley, of the schooner "H. A. Duncan," and presented by him to the U. S. Fish Commission, 1879. A smaller, mutilated specimen was also taken from the stomach of a halibut, from Banquereau, off N. S., in 150 fathoms (lot 678), and presented to the U. S. Fish Commission, by Captain Charles Markuson and crew, of the schooner "Notice," April, 1880. The latter specimen was, however, in too poor condition to afford any additional characters, and may, perhaps, belong to *O. lentus*.

This species differs from *Octopus Bairdii* V., *O. lentus* V. and *O. piscatorum* V., from the same region, in its longer and larger body, and especially in having the basal suckers in a single row. The 'spoon' of the hectocotylized arm is very much larger than in *O. Grönlandicus*, and considerably larger and flatter and more deeply trilobed at the end than in *O. Bairdii*.

### Eledone Leach.

*Octopus* (*pars*) Lamarck; Cuvier; Blainville, etc.

*Eledone* Leach, Zool. Misc., iii, 137, 1817 (t. Gray); D'Orbig. Céphal. Acétab., p. 72 (subgenus); Gray, Catal. Moll. Brit. Mus., i, p. 21, 1849.

Body, mantle, and siphon as in *Octopus*. Suckers in a single row on all the arms. In the male the right arm of the third pair is hectocotylized by the formation of a small spoon-shaped tip and a lateral groove, nearly as in some species of *Octopus*.

### Eledone verrucosa Verrill.

Bulletin Mus. Comp. Zool., viii, p. 105, pl. 5, 6, March, 1881.

PLATES LII, LIII.

A stout species, covered above with prominent, rough, wart-like tubercles, and with a circle of the same around the eyes; four or five of those above the eyes are larger and more prominent. Body thick, broad-ovate, swollen beneath, moderately convex above, obtusely rounded posteriorly.

Male: Head as broad as the body, whole upper surface of body and head to base of arms covered with prominent and persistent, unequal warts, which are roughened by sharp, conical papillæ, eight or ten on the larger warts, but only two or three on the smaller ones; the warts diminish in size anteriorly, and on the sides, before they disappear; around the eyes they form irregular circles; just above each of the eyes there are two much larger ones, bearing more than twenty conical papillæ; there is one before and one behind these, of somewhat smaller size. Eyes large, the lower lid purple and thickened, overlapping the upper one, which is thin and whitish.

Arms considerably longer than the head and body, not very stout, compressed, bearing a single crowded row of large whitish suckers, which are mostly separated by spaces less than half their diameter; margins of suckers soft and much thickened. The three lower pairs of arms are very nearly equal in length and size; the dorsal ones are a little shorter and smaller. A thin web unites all the arms for about one-fourth of their length, and runs up along their sides for about half their length. The male has the third right arm (Plate LII, fig. 1, 1*a*) hectocotylized at the tip; the modified tip is preceded by forty-five suckers, and is bordered ventrally by a broad membrane, having a white groove along its inner surface; the terminal organ (fig. 1*a*) consists of a small, ovate-triangular, fleshy disk, with its inner surface slightly concave and finely wrinkled transversely, and terminating proximally in a small point.

Color dark purplish brown, darker purple beneath. Chromatophores small and densely crowded.

The female is considerably larger than the male, and has the warts over the back and around the eyes relatively smaller, but of the same character. The arms appear to be larger than those of the male, but this is probably due to the fact that the male has become more contracted by the stronger alcohol in which it was placed.

This female specimen illustrates well the uselessness of the attempts to divide the species of *Octopus* and allied genera into groups or sections, according to the relative length of the arms, as J. E. Gray and others have done, for in this and many other cases the proportions of the arms of the right side would throw it into one section; those of the left side into another. The male would have to be put into a third section.

The two known examples of this species were taken by Mr. A. Agassiz, while dredging on the United States Coast Survey steamer "Blake," in 1880.

*Measurements in millimeters.*

| | No. 12. ♂ | No. 13. ♀ Right Side. | Left Side. |
|---|---|---|---|
| Total length | 202· | 360· | |
| End of body to center of eye | 58· | 100· | |
| Breadth of body | 55· | 65· | |
| Breadth across eyes | 49· | | |
| Length of dorsal arms, from mouth | 135· | 255· | 260· |
| Length of second pair of arms | 155· | 260· | 235· |
| Length of third pair of arms | | 225· | 240· |
| Length of hectocotylized arm | 130· | | |
| Length of modified tip | 4·5 | | |
| Length of ventral arms | 145· | 210· | 225· |
| Greatest breadth of lateral arms | 12· | 18· | 18· |
| Diameter of largest suckers | 3· | 5· | 5· |

*Specimens examined.*

| No. | Stat. | Locality. | Fath. | When rec'd. | Specimens. No. | Sex. |
|---|---|---|---|---|---|---|
| 12 | 305 | N. Lat. 41° 33′ 15″; W. Long. 65° 51′ 25″ | 810 | 1880 | 1 | ♂ |
| 13 | 312 | N. Lat. 39° 50′ 45″; W. Long. 70° 11′ | 466 | 1880 | 1 | ♀ |

## Family CIRRHOTEUTHIDÆ Keff.

Kefferstein, in Bronn, Thier-Reich, iii, p. 1448, 1866.

Body somewhat elongated, furnished with a short, thick tapering fin on each side, supported by an internal transverse cartilage. Mantle extensively united to the head. No connective cartilages. Arms united together nearly to the tips by a broad umbrella-shaped membrane or web. Suckers in a single row, alternating with slender cirri.

### Stauroteuthis Verrill.

Verrill, American Journal of Science, vol. xviii, p. 468, Dec., 1879.

Allied to *Cirrhoteuthis*, but with the mantle united to the head all around, and to the dorsal side of the slender siphon, which it surrounds like a close collar, leaving only a very narrow opening around the base of the siphon, laterally and ventrally. Fins long-triangular, in advance of the middle of the body. Dorsal cartilage forming a median angle, directed backward. Body flattened, soft, bordered by a membrane. Eyes covered by the integument. Web not reaching the tips of the arms, the edge concave in the intervals. Suckers in one row, with a pair of slender cirri alternating with them along most of the arm. Cirri absent between the basal and terminal suckers.

### Stauroteuthis syrtensis Verrill.

Amer. Jour. Sci., vol. xviii, p. 468, Dec., 1879; xix, p. 294, pl. xvi, Apr., 1880.

PLATE XXXII, FIGURES 1–5.

Female: Head broad, depressed, not very distinct from the body. Eyes large. Body elongated, flattened, soft or gelatinous, widest in

the middle, narrowed but little forward, but decidedly tapered, back of the fins, to the flat, obtuse, or subtruncate tail. The sides of the head and of the body, forward of the fins, are bordered by a thin soft membrane, about 12$^{mm}$ wide. The fins are elongated, sub-triangular, obtusely pointed, placed in advance of the middle of the body; supported by internal cartilages, which unite with a transverse dorsal V-shaped one, situated behind the fins. Siphon elongated (about 12$^{mm}$), slender, round, with a small terminal opening. Mantle edge is contracted and thickened around the base of the siphon so as to show only a very small opening, and is united to its anterior or dorsal commissural band. Eyes large, distinctly visible through the integument. Arms long, slender, sub-equal, each united to the great web by a broad membrane developed on its outer side, widest (about 38$^{mm}$ or 1·5 inches) in the middle of the arm, while the edge of the web unites directly to the sides of the arms and runs along the free portion toward the very slender tip, as a border. This arrangement gives a swollen or campanulate form to the extended web. Edges of the web incurved between the arms, widest between the two lateral pairs of arms. The arms bear each fifty-five or more suckers, in a single row. Those in the middle region are wide-apart (12$^{mm}$ or more), with a pair of slender, thread-like cirri, about 25 to 32$^{mm}$ long, midway between them. The cirri commence, in a rudimentary form, between the 5th and 6th suckers, on the dorsal arms, and between the 7th and 8th, on the lateral and ventral ones. They cease before the 23d sucker on the dorsal and lateral arms, and before the 22d on the ventral ones, which bear each 14 pairs of cirri. Near the mouth, and beyond the last cirri, on the free portion of the arms, the suckers are more closely arranged. The jaws are small, with a deep cavity. Beyond the last cirri, on the dorsal arms, there are 33 to 35 small suckers. The 2d arm on the right side appears to be imperfect. On this arm there are but 19 suckers beyond the last cirri; then follow minute, wart-like tubercles, extending to the tip. Color, in alcohol, generally pale with irregular mottlings and streaks of dull brownish; inner surface of arms and web, toward the base, and membrane around the mouth, deep purplish brown. Length from end of body to base of arms, 160$^{mm}$; length to posterior base of fins, 63$^{mm}$; to anterior base, 101$^{mm}$; width across fins, 126$^{mm}$; in advance of fins, 53$^{mm}$ (not including lateral membrane); across eyes, 44$^{mm}$; across end of tail, 30$^{mm}$; diameter of eye, 25$^{mm}$; width of fins, at base, 33$^{mm}$; their length, 44$^{mm}$; length of arms, 330$^{mm}$ to 355$^{mm}$; portion beyond web, 63 to 76$^{mm}$. Edge of extended web, between upper arms, about 101$^{mm}$; between lateral

arms, about 203$^{mm}$; entire circumference of web, about 1218$^{mm}$, but its exact extent cannot be ascertained, because, in our specimen, the web between the ventral arms was badly torn.

The only known example of this remarkable species was taken by Capt. Melvin Gilpatrick and crew, schooner "Polar Wave," in N. lat. 43° 54′; W. long. 58° 44′, on Banquereau, about 30 miles E. of Sable I., N. S., in 250 fathoms. Presented to the U. S. Fish Commission, Sept. 1879 (lot 472).

*Notes on the Visceral Anatomy.*

The anatomy of this species is very peculiar, but as the original specimen still remains unique, and is not in very good preservation, internally, I do not propose to give more than a few anatomical notes on this occasion. The ventral wall of the mantle cavity is extensively bound down to the visceral mass over a wide central area, by connective and muscular tissue, which does not form a definite septum, found in most other Dibranchiata. This central area underlies, especially, the large nidamental glands and oviduct. Farther back the two sides of the branchial cavity are in communication.

The gills are very peculiar. Each one consists of a short and broad, ovate group or cluster of very much folded or convoluted lamellæ attached directly to the inner surface of the mantle by one edge, and having the free edge much frilled and crisped.

These lamellæ have, however, a somewhat transverse arrangement, and one or two of those nearest the base of the gill, on each side of its median line, are more simple, and are separate from the rest, but those farther out become confluent across the median line, and lose their distinctness. There appears to be about four or five principal lamellæ on each side of the middle line of the gill.

The oviduct is single and nearly median, its orifice being a little to the left of the median line. A large nidamental gland, consisting of a posterior, yellowish portion, and a much larger, round, dark brown, anterior portion, surrounds the oviduct; the portion behind these glands is thin, tubular, and contains large round ova.

The anterior portion, in front of the glands, is large and much thickened, and terminates in a slightly bilabiate orifice, at the base of the siphon. From the portion of the oviduct in front of the large glands I took a large mature egg, covered with a hard, dark reddish brown case. This egg, seen endwise, has a broad elliptical outline, and while the two ends are truncated and smoothish, the sides are ornamented with numerous regular, roughened, elevated ribs. Greatest breadth of the egg, 11$^{mm}$; lesser breadth, 7$^{mm}$; length, 6$^{mm}$. The anal orifice is not raised on a distinct elevation. A small urethral papilla arises in front of the base of each gill.